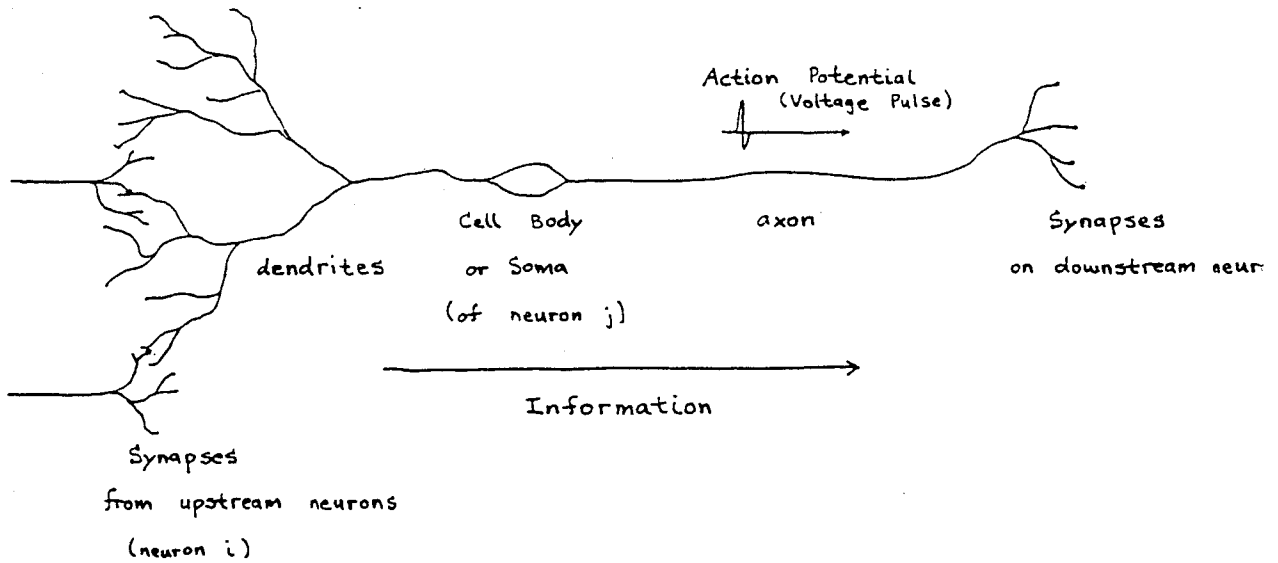


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# Perceptrons - Biological Neuron

## Neuron - Anatomy



Weighted Sum of Input Activity:

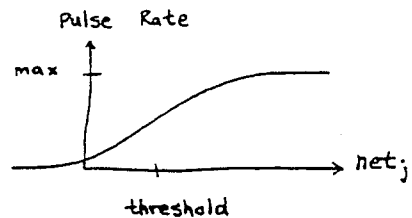
$$\sum_i w_{ji} x_i = \text{net}_j$$

$w_{ji} \equiv$  synaptic weight from neuron  $i$  upstream to neuron  $j$  downstream (strength of connection)

$x_i \equiv$  input firing rate

Generation of pulses.

Rate of pulses is nonlinear function of input activity:



- Neuron is specialized cell that processes electrical pulses
- Pulses (Action Potentials) generated by flow of ions,  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Cl}^-$ ,  $\text{Ca}^{++}$  through nerve cell's membrane. Ions (salt water) are electrically charged  $\Rightarrow$  ion flow implies electrical currents, voltages.
- Action potentials always (almost) have same shape.  
Max pulse rate typically  $\approx 300$  Hz. Pulse  $-50$  mV to  $+50$  mV =  $100$  mV h  
Pulse duration 1 msec
- # neurons in brain  $\approx 10^{10}$ , # synapses per neuron  $\approx 10^3$ , # pulses/sec  $\approx 10^2$  /ne  
 $\Rightarrow$  Total # pulses/sec  $\approx 10^{15}$  each approx. equiv. to multiply  $\Rightarrow 10^{15}$  FLOPS
- Power consumption of brain  $\approx 10$  Watts